Regulations for Mining Work are also attached. The revised rules are certainly an improvement on the previous edition, and the rearrangement and enlargement under the different headings tend to simplify them greatly.

THE May issue of the *Westminster Review* contains an appreciative unsigned article on the life and work of the late Prof. Marcellin Berthelot. This biographical notice, in addition to its references to Berthelot's achievements in science, provides much interesting information concerning his private life and his services to France in administrative matters.

OUR ASTRONOMICAL COLUMN.

A NEBULOUS BACKGROUND IN TAURUS.—In No. 3, vol. xxv. (p. 218, April), of the *Astrophysical Journal*, Prof. Barnard discusses the apparently nebulous background shown on some excellent photographs of a region in the constellation Taurus, of which two reproductions are given.

The vacant lanes among the Milky Way stars in Ophiuchus suggest from their appearance that not only are they due to the absence of stars, but that they are really darker than the rest of the sky, that is, they are probably channels in a substratum of nebulous matter. The recent photographs obtained by Prof. Barnard show that lanes of this nature are undoubtedly in a substratum of some kind, and not merely a subjective effect of contrast in a region otherwise densely packed with stars.

The region dealt with is comprised between the limits α=4h. 0m. to 4h. 34m. and $\delta = +24°$ to $28\frac{1}{2}°$, well to the east of the Pleiades, and shows numerous narrow, vacant lanes, one of which is singularly well defined, and extends for some 26m. in R.A. Another feature is a large space, nearly devoid of stars, but containing a large nebula which seems to suggest the possible existence of a larger nebula of which the outlying portions are dead or non-luminous, and therefore absorb the light of the stars behind them.

THE WHITE SPOT ON JUPITER'S THIRD SATELLITE.—Referring to the white spot near the north limb of Jupiter's third satellite, observed by Senor José Comas Solá in November, 1906 (see NATURE, No. 1942, p. 281, January 17), Prof. Barnard directs attention to the fact that he observed the same, or a similar, spot some fourteen years ago, and that, as in Senor Solá's observations, it was only seen when the satellite was *following* Jupiter. This leads to the assumption that this feature cannot be a true polar cap in the sense of its being at the pole, or it would be seen with equal facility in all parts of the satellite's orbit. Further, if this white spot is an extra-polar marking, and is only visible in certain points of the satellite's orbit with respect to the earth, it indicates that Jupiter's third moon, like the earth's satellite, always keeps the same face towards its primary.

During the observations of 1893–4, Prof. Barnard saw a similar spot at the south limb of the fourth satellite when that body was near superior conjunction (*Astronomische Nachrichten*, No. 4173, p. 327, April 27).

THE METEORITE FROM RICH MOUNTAIN, NORTH CAROLINA.—The results of a minute examination of a portion of the meteorite which was seen to fall at Rich Mountain, Jackson County, North Carolina, "about June 20, 1903, at 2 o'clock in the day," are given by Messrs. Merrill and Tassin in an abstract (No. 1524) from the Proceedings of the U.S. National Museum (vol. xxxii., pp. 241–244, April 18).

The portion examined seemed to be the nose of a larger mass, and weighed 668 grams. Metallic iron particles project from the crust, and seem to have resisted the frictional heat of the atmosphere better than did the silicate portions. Chemical analysis showed about 7 per cent. of iron, nearly 47 per cent. of olivine, about 4 per cent. of troilite, and about 40·7 per cent. of insoluble silicates. Copper was apparently absent, and, among the compounds, chromite was not found, whilst a relatively large amount of graphitic carbon was present.

COMET 1907*b* (MELLISH).—In No. 4174 (p. 347, May 3) of the *Astronomische Nachrichten*, Prof. Berberich directs attention to the great similarity between the elements of the orbit of comet 1907*b* and those of the bright comet of 1742 as published in vol. clxxii. (p. 105) of the same journal.

Prof. Barnard has discovered an image of this comet on a plate taken on April 13, the day before the object was found by Mr. Mellish, and a number of other American observations are also recorded for April 14, 15, and 17 in the same journal.

THE ORBITS OF FOUR DOUBLE STARS.—Recently determined orbits of the systems of ξ Scorpii, Σ 2173, Σ 3121, and μ^2 Herculis are given by Dr. Doberck in Nos. 4169–70 (p. 257, April 17) of the *Astronomische Nachrichten.* The orbits were determined by successive corrections by the least-square method, and the computed places are compared with all the available observational results; ephemerides extending to 1926 are also given. The periods given by the final elements for each of the above stars are 45·12, 46·20, 35·38, and 44·20 years respectively.

THE DISCOVERY OF VARIABLE STARS.—The value of the new method of discovering, photographically, variable stars, by superposing a negative and a positive copy of a similar negative taken at a different epoch, is illustrated in Circular No. 127 of the Harvard College Observatory. A plan has been started whereby the whole of the sky, as photographed on the Harvard Map of the Sky, will be systematically examined for variables, and the present circular deals with two regions already examined by Miss Leavitt; eight new variables were found in the one region and six in the other. A comparison of the results with those previously obtained shows that apparently all the bright variables exhibiting conspicuous changes in these two regions have now been discovered.

THE RADIANT POINT OF THE BIELIDS.—From observations made at Stockholm in November, 1904, Dr. Karl Bohlin finds the radiant point of the Bielid shower, epoch November 21·33 (M.E.T.), to have been $\alpha = +26° 2'$, $\delta = +44° 10'$ (1900). The record of the observations and discussion of the results appear with a chart, in No. 2, vol. viii., of the *Astronomiska Iakttagelser och Undersökningar å Stockholms Observatorium.*

IRON AND STEEL INSTITUTE.

THE annual meeting of the Iron and Steel Institute was held at the Institution of Civil Engineers, Westminster, on May 9 and 10. The proceedings opened with the Right Hon. Sir James Kitson, Bart., M.P., past-president, in the chair, who explained that the president, Mr. R. A. Hadfield, having attended to present an address on behalf of the institute at the dedication of the building given by Mr. Carnegie to American engineering societies, was unable to return to England in time for the meeting.

The report of the council, which was read by the secretary, Mr. Bennett H. Brough, showed that the past year had been one of exceptional activity and progress. The membership of the institute amounted to 2052, and the joint meeting with the American Institute of Mining Engineers resulted in the presentation of so large a number of papers that it was found impossible to compress the minutes into the usual two volumes, and two extra volumes were issued. The report by the treasurer, Mr. W. H. Bleckly, showed that the financial prosperity of the institute is a matter for congratulation. The receipts amounted to 6610*l.*, and the expediture to 5915*l.*

The first act of the new president, Sir Hugh Bell, Bart., on taking the chair was to present the Bessemer gold medal to Mr. J. A. Brinell, the eminent Swedish metallurgist.

In his presidential address, Sir Hugh Bell gave a sketch of the iron trade in the last hundred years, the subject being chosen from the fact that the life of his father, Sir Lowthian Bell, begun in 1816 and ended nearly ninety years later, almost covered the period reviewed. The address is a work of conspicuous literary merit, and its value is enhanced by the addition of a carefully compiled chronological table of the more important events connected with iron and steel during the century. A vote of thanks to the president for his address was eloquently proposed by Sir W. H. White and seconded by Mr. Schneider (Le Creusot).

The first paper read was by Mr. D. Selby-Bigge (Newcastle-on-Tyne), who described the latest application of electricity to reversing rolling-mills of high power. The first mill of this kind was started on July 27 last at the Hildegarde Works, at Trzynietz, in Austrian Silesia. The mill is of 10,350 horse-power, and is provided with the Ilgner arrangement of fly-wheel converters. The discussion was well sustained, and the rival claims of electricity and steam were ably urged.

The secretary announced that Carnegie research scholarships had been awarded by the council to C. A. Edwards (Horwich), J. A. N. Friend (Germany), D. M. Levy (Bradford), A. M. Portevin (France), A. K. F. Hiorth (Norway), and B. Saklatwalla (India and Germany). For research work carried out during the past year, medals were awarded to E. F. Law (London) and Dr. O. Stutzer (Freiberg in Saxony). The reports of these two candidates, and the reports of P. Breuil (Paris), W. H. Hatfield (Sheffield), and Dr. Guillet (Paris) were found to be of sufficient merit to warrant their publication in full in the journal of the institute.

Two papers were read by Mr. Arthur W. Richards describing processes he has adopted at the works of Messrs. Bolckow, Vaughan and Co. for the manufacture of steel from high-silicon phosphoric pig iron by the basic Bessemer process, and of high-class steel from pig iron containing chromium, nickel, and cobalt.

Prof. W. A. Bone, F.R.S. (Leeds), and Mr. R. V. Wheeler (Warrington) read a lengthy paper on the use of steam in gas-producer plant. The experiments were made with a Mond gas-producer plant with the view of determining the influence of variation in the proportions of air and steam in the blast upon the composition of the gas, its suitability for furnace operations, and upon the general and thermal efficiencies of the producers. The quality of the gas obtained, though always good, steadily deteriorated as the steam saturation temperature was raised beyond 65°. An investigation of the thermal efficiency showed that the use of steam beyond that required to saturate the air blast at 60° was not attended by any increased economy of working, but rather the reverse. If, however, a gas producer be regarded primarily as an apparatus for ammonia recovery, then undoubtedly it should be worked with the highest steam saturation temperature consistent with the production of combustible gas.

The paper read by Mr. F. W. Harbord (London) is a valuable addition to technical literature. For many years it has been recognised that steels made by different processes, although practically of the same composition, varied in their tensile strength, hardness, and other physical properties, and it has been generally admitted that basic Bessemer steel was softer than acid Bessemer, and basic open-hearth softer than acid open-hearth steel. Mr. Harbord's paper gives for the first time systematic experimental results defining these various differences over a wide range of carbon content. He shows that if engineers wish to obtain rails of equal hardness from the basic open-hearth that they have been accustomed to from acid Bessemer steel, they must permit the manufacturer to increase the percentage of carbon to give the required hardness, as otherwise, although the rails may satisfactorily pass all the usual tests required by the specification, there will soon arise, under the conditions of heavy train-loads now customary, serious trouble due to spreading heads and undue wear. American engineers, in their standard specifications, have already recognised the importance of this, and they vary their rail specifications according to the process of manufacture.

A paper on the ageing of mild steel was read by Mr. C. E. Stromeyer (Manchester). The idea that steel might go through an ageing process has been scouted, but from the tests described the conclusions to be drawn are that certain steels do possess ageing qualities, that some steels tend to improve with time, others to deteriorate; and that as yet the process which gives results which are most in harmony with practical experience is to plane the edges of two samples, to nick them with a specially prepared chisel, and then to bend one sample at once and the other after waiting some weeks or after boiling.

Mr. A. J. Capron (Sheffield) read a paper on induced draught, with hot air economisers, for steel works and blast-furnace boilers. Briefly, the system consists of induced draught in combination with hot air economisers, which utilise the waste heat from the boiler in heating the air required for combustion. A fan is placed at the base of the chimney and draws the gases, as they come from the boiler, through a series of tubes which form a heating-box or hot air economiser. The system has already been adopted at several iron and steel works, and is found to result in considerable economy of fuel and absence of smoke. There is also the advantage that no high chimney is required.

A paper on the distribution of sulphur in metal ingot moulds was contributed by Mr. J. Henderson (Stockton-on-Tees). The question of the distribution of sulphur in ingot moulds made of hæmatite pig iron was recently brought to his notice by the fact that several large moulds were alleged to contain an excessive percentage of sulphur out of all proportion to the sulphur contents of the pig iron from which the moulds were made. The fact that much more sulphur is generally found in the tops of ingot moulds and other large castings is, or should be, well known to all ingot-mould makers and users. Yet in spite of this it is evident that some steel makers drill the tops of the moulds in order to ascertain the sulphur contents, and on the results so obtained condemn the moulds as unfit for use in the open-hearth furnace for melting purposes when they are scrapped. Such a method of sampling is manifestly unfair, as the results obtained by the author show that the excessive sulphur does not go deeper than the first inch, and that after the second inch there is no reason to find fault with the composition of the mould.

A paper on sentinel pyrometers and their application to the annealing, hardening, and general heat treatment of tool-steel was contributed by Mr. H. Brearley (Riga, Russia) and Mr. F. C. Moorwood (Sheffield). An indicator which can, in most cases, be placed exactly on the spot the temperature of which is required to be ascertained may occasionally be more serviceable than a fixed pyrometer of a more expensive type which registers the temperature of its immediate vicinity only. By making the indicators from materials which clearly melt at or above a definite temperature, and, after melting, also continue to show when the temperature falls to or below that point, a simple means is discovered which may claim a place amongst instruments of precision. The authors suggest that, for this purpose, no more suitable materials could be adopted than well-chosen salts of the metallic oxides.

In a paper on carbon-tungsten steels contributed by Mr. Thomas Swinden (Sheffield), a research is described having for its object an investigation of the influence of varying percentages of carbon in the presence of a constant percentage of tungsten.

Reports on research work carried out by holders of Carnegie research scholarships were also presented. Mr. P. Breuil (Paris) gave the results of a systematic investigation of copper steels from the point of view of their industrial application. Mr. W. H. Hatfield (Sheffield), in a research on cast iron, found that there is undoubtedly occasionally a great variation in the strength of cast irons of the same composition as cast; that this variation does not appear to follow any distinct rule with regard to the temperature of the casting operations; that a difference in mechanical tests is generally accompanied by a difference in the microstructure; and that the inequalities of the metal can be rectified by judicious heat treatment, *i.e.* the irregularity need not persist after heat treatment, at any rate under certain conditions. Dr. O. Stutzer (Freiberg, Saxony) gave the results of an elaborate investigation of the genesis of the Lapland iron ore deposits, showing that the phosphoric magnetite deposits of north Sweden are all associated with plutonic rocks of the syenite family, and that they have been formed in a magmatic manner, and, indeed, either as magmatic separations *in situ* or as erratic magmatic segregation. Pneumatolysis has also had considerable influence in the formation of these ores.

Mr. E. F. Law (London) dealt with the non-metallic impurities in steel. His paper is the result of an examination of more than one hundred steels. The impurities have been considered as consisting of five in number, namely, iron sulphide, manganese sulphide, iron silicate, manganese silicate, and iron oxide. Iron sulphide very rarely occurs in commercial steels, and is therefore not considered at length. Manganese sulphide is always present in steel, and is usually harmless. The only instance in which it has been found to exert injurious influence on the quality of the steel is when it segregates with phosphide of iron in the form of "ghosts." Silicates of manganese and iron are frequently found in steel, and are highly injurious to the quality of the metal. In large forgings they sometimes occur in considerable masses, but in rolled steel they are distributed throughout the mass. In either case they are responsible for many failures. No indication of their presence is afforded by ordinary commercial means, and they can only be detected under the microscope. Oxide of iron frequently occurs in Bessemer steel. It occurs in a finely divided state, and there is evidence that it is soluble in steel. As a general rule, steels which on pickling evince a tendency to blistering are high in oxygen. The effect of hydrogen on steel containing oxide is discussed, and experiments were made with the view of determining the temperature at which the oxide is reduced. The results of these experiments tend to show that the oxide is reduced at 100° C. Iron oxide differs from other impurities present in its electrical behaviour, and the influence of this difference on the corrosion of iron and steel is discussed. It has been found that the presence of oxide accelerates corrosion, and corrosion of welded iron affords an illustration of this action. Other instances of the effects of the presence of oxide may be found in the pitting of boiler plates and tubes.

The last paper on the programme dealt with the nomenclature of iron and steel. This is the report of an influential committee of the International Association for Testing Materials which was presented by Prof. H. M. Howe (New York) and Prof. A. Sauveur (Harvard) at the Brussels congress of that association. It was then proposed that the report be submitted to the Iron and Steel Institute for consideration, and the secretary will be pleased to receive written comments for publication in the journal.

The meeting concluded with the usual votes of thanks to the Institution of Civil Engineers, proposed by the president and seconded by Sir John Alleyne, and to the president, proposed by Mr. G. Hawksley and seconded by Mr. Saladin (Le Creusot).

On Friday evening the annual banquet was held, with the president in the chair. Four hundred members were present, and the speakers were the Austrian Ambassador, the Swedish Minister, Sir James Kitson, Mr. Yves Guyot, Admiral Sir Cyprian Bridge, Sir C. E. Howard Vincent, Lord Justice Fletcher Moulton, and Mr. Robert Hammond.

CHIMÆROID FISHES.

A MEMOIR on "Chimæroid Fishes and their Development," by Prof. Bashford Dean, has been issued as Publication No. 32 of the Carnegie Institution of Washington. It begins with a short review of the researches in comparative anatomy and palæontology, which led to the view that chimæroid fishes are the most primitive vertebrates or the least modified descendants of the ancestral cranium- or jaw-bearing vertebrate; that, although shark-like, they are nevertheless widely distinct from the shark; and that altogether they represent a lower plane in piscine evolution.

Admitting the importance of the grounds on which these conclusions were based, Prof. Dean refers to the incomplete nature of the evidence. The material at the disposal of investigators was inadequate for the solution of the great morphological problems involved, and especially embryological material was extremely scanty or absent. The author himself failed for several years in his efforts to obtain satisfactory materials, until his attention was directed by President Jordan to the vicinity of the Hopkins Marine Laboratory at Monterey as a promising locality for collecting *Chimaera colliei.* Under the guidance of a Chinese fisherman, Ah Tack Lee, who not only possessed a perfect knowledge of the Chimæra grounds, but proved to be a keen observer of the habits of the fish, the author obtained hundreds of specimens of the adult fish and of ova. Such of the latter as were not required for immediate examination were placed in a case, which was then sunk, attached to a buoy, in water of about five fathoms, to obtain the much needed series of developmental stages.

After having given an account of the habits and mode of propagation of the Californian Chimæra, the author enters into a full description of its egg and capsule in comparison with the ova of other Chimæroids. This is followed by a detailed account of the various stages of development of the embryo and of the post-larval growth of the fish. Next the relationships of fossil Holocephales are considered. In the chapter on organogeny, the discussion of the obscure problem of the development of the dentition and of the homologies of its component parts in living and extinct forms will be studied with particular interest.

Anatomical, embryological, and palæontological evidence, then, appears to the author to be unmistakably in favour of Chimæroids being widely modified rather than primitive forms. The recent forms retain less perfectly the general characters of the ancestral gnathostome than do living sharks. On the other hand, they have retained several characters of their Palæozoic Selachian ancestors which modern sharks have lost. The ancestral Holocephali diverged from the Selachian stem near or even within the group of the Palæozoic Cestracionts, and the many features of kinship retained by the recent Chimæroids and Cestracionts distinctly point at this line of evolution.

The memoir is illustrated by 144 excellent text-figures and eleven plates.

BRITANNIC GEOLOGY.

FEW teachers have utilised the study of our own islands to greater advantage than Dr. Joseph H. Cowham, of the Westminster Training College. For thirty years past he has led his pupils over the varied country south of London, and the present writer is one of those who became pleasantly acquainted at an early date with his interest in scenery and his keenness for the details of a landscape. Dr. Cowham has published in "The School Journey" (Simpkin Marshall, pp. 80, price 1*s.*) an account of his methods, illustrated in the country between Croydon and Godstone; Mr. G. G. Lewis, a former pupil, describes an excursion in the Greenwich and Woolwich area; and Mr. T. Crashaw, another pupil, shows how a class may study erosion and deposition in river-courses on the banks of the Calder, in Lancashire. These expeditions appear to be wisely accepted as part of the regular school curriculum, instead of being relegated, as sometimes happens, to the holidays. Their effect in bringing together teacher and taught is rightly insisted on, and cannot be exaggerated; and the feeling is early engendered that the class-instruction in geography relates to something real and natural, which any eye can see and any willing brain can comprehend.

G. A. J. Cole

It is to such teachers, and to their pupils in later years, that the long-established Geologists' Association especially appeals. In part x. of its Proceedings (November, 1906, Stanford, price 1*s.* 6*d.*) Mr. R. S. Herries describes the geology of the Yorkshire coast between Redcar and Robin Hood's Bay, which was the scene of the long excursion of 1906. Especial interest here attaches to the estuarine representatives of the Middle Jurassic series, with *Equisetum columnare* "found upright in the sandstones as it originally grew," and to the zoning of the Lower Jurassic by the abundant ammonites. The valuable "Sketch of the Geology of the Birmingham District," by Prof. Lapworth, with a contribution on petrology by Prof. Watts and one on the glaciers by Mr. W. Jerome Harrison, has now been reprinted from the Proceedings of the Geologists' Association for 1898 (Cornish Bros., Birmingham, pp. viii+104, price 2*s.* net), and will serve as a guide for generations of students in